PRESCHOOL CHILDREN'S COLLABORATIVE PROBLEM-SOLVING INTERACTIONS: INFLUENCE OF TASK, PARTNER GENDER, AND GENDER DIFFERENCES IN CONVERSATIONAL STYLE

By

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Abstract of Dissertation Presented to the Graduate School
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PRESCHOOL CHILDREN'S COLLABORATIVE PROBLEM-SOLVING INTERACTIONS: INFLUENCE OF TASK, PARTNER GENDER AND GENDER DIFFERENCES IN CONVERSATIONAL STYLE

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The general aim of the project was to investigate the relationship between children's gender-typed conversational styles and their joint problem-solving task performance. No studies have investigated the role of gender-typed language use in preschool children's collaborative problem-solving. This study extended previous free play research to the cognitive domain by examining the use of gender-typed language in a problem-solving context and its influence on children's performance in mixed-sex and same-sex dyads. Preschool children between the ages of 4 and 5 1/2 years of age completed three problem-tasks with either a same-sex or an opposite-sex peer. Children's conversations were analyzed for their gender-typed language content, including the use of aggressive and mitigated speech in conflict resolution. Girls used mitigation more often than boys.

Mixed-sex dyads used a masculine, aggressive style of conversation more often than same-sex dyads. While children's overall performance did not differ across the three tasks, there were differences in the verbal and behavioral measures that were associated with success on each task. The relationships between these measures and task performance also differed across pair types. The results of the study indicate that preschool children do utilize collaborative skills in joint problem-solving interactions, and that the use of these skills across different tasks and in a variety of contexts deserves further study.

INTRODUCTION

Much research, particularly with the recent reemergence of Vygotskian theory, has been devoted to the question of whether children's problem-solving performance or abilities are improved by social interaction with peers. A second line of research, also gaining more recognition of late, has been concerned with children's acquisition of gender-typed language and the use of such language in conflict resolution during free play. While it is generally acknowledged that peer collaboration is beneficial to children's cognitive development, the influence of gender differences in conversational style on the process of peer collaboration has not been studied. The goal of the present study is to bring these two areas of research together by examining children's gender-typed language use in a problem-solving context.

It is generally accepted that peer collaboration is often beneficial for children's learning (Azmitia, in press; Azmitia & Perlmutter, 1989; Rogoff, 1990; Tomasello, Kruger, & Ratner, 1993). Research on children's joint problem-solving has utilized a range of tasks to study a variety of concepts, including conservation (Miller & Brownell, 1975), planning (Gauvain & Rogoff, 1989), math and spatial concepts (Phelps & Damon, 1989), and moral development (Kruger & Tomasello, 1986). Most of these studies have focused on elementary school-aged or older children; few studies have examined the role peer collaboration might play in preschool children's cognitive development. We do know that preschoolers spontaneously collaborate with one another in free play (Azmitia, in press; Goncu & Kessel, 1988; Sheldon, 1990; Verba, 1994) and on more structured learning tasks as well (Muller & Perlmutter, 1985). A few studies have also shown that very young children can work together to solve problems presented by an experimenter (e.g., Azmitia, 1988; Brownell & Carriger, 1991). However, there has been little study of the processes of preschool children's joint problem-solving, particularly the types of discussion in which preschool children engage during collaborative interactions. One goal of the present research will be to analyze preschool children's conversation that occurs during collaborative problem-solving, particularly children's gender-typed conversation.

During the preschool years, children are learning styles of language that are gender-related (Maccoby, 1990; Miller, Danaher, & Forbes, 1986; Sheldon, 1990, 1992a).

Boys' interactions are often centered around hierarchical negotiation of status and establishing dominance; as a result, there tends to be a focus on the self. For example, boys are concerned with the presentation of the self to the other person, as well as achieving individual goals during the interaction (Goodwin, 1988; Maccoby, 1990; Sheldon, 1990, 1992a). Boys accomplish these goals by using more aggressive speech acts such as threats, bald directives, and bragging (Austin, Salehi, & Leffler, 1987; Goodwin, 1988; Leaper, 1991; McCloskey & Coleman, 1992; Miller et al., 1986). Girls, on the other hand, tend to focus more on the social aspects of the interaction, particularly the maintenance of the interaction. While they do negotiate various aspects of their play, they do so in a parallel, collaborative way. They use more mitigating speech acts, such as directives in the form of suggestions, providing rationales, and offering compromises (Goodwin, 1988; Hartup, French, Laursen, Johnston, & Ogawa, 1993; Sheldon, 1990). These findings indicate that girls approach interpersonal interactions in a very different manner from boys. Girls are oriented outward, toward the social relationship, rather than inward toward the self. They are less concerned with negotiation of status or control and more concerned with joint participation (Goodwin, 1988; Sheldon, 1990).

One particular interpersonal context in which these gender differences in speech styles are especially evident is children's use of strategies to resolve conflicts. Studies that have examined gender differences in conflict management or conflict resolution have primarily focused on conflicts that occur during children's free play. These studies indicate that, at least for children engaged in same-sex interactions, the differences that characterize girls' and boys' interactions in general are often magnified during conflict situations. Miller et al. (1986) found that, while girls did engage in conflict episodes, they were more likely to use conversational strategies that served to defuse or mitigate conflicts, such as clarifying the other person's feelings, changing the topic, or offering compromises. In addition, girls used moderate, verbal persuasion tactics rather than heavy-handed physical persuasion tactics. Miller et al. also found that boys experienced more conflicts overall, and they were significantly more likely to engage in persuasion attempts that involved threats or actual physical force. Other studies have shown that when boys do use verbal strategies to resolve conflicts, their strategies tend to be more controlling or aggravated. For example, boys issue direct commands more often than girls do, and they are less likely than girls to provide rationales for assertions (Hartup et al., 1993; Killen & Naigles, 1993). Boys also use justifications as a means of controlling their partners, whereas girls use justifications to achieve joint goals rather than individual goals (Kyratzis, 1992).

Sheldon (1990, 1992a, 1992b) takes a slightly different position regarding gender differences in conflict negotiation styles. She argues that girls cannot engage in the type of direct, aggressive confrontations that boys do because they must be concerned with the feelings of others involved and with maintaining interpersonal harmony. She states that girls develop a dual orientation toward interpersonal interaction: They are oriented toward pursuing an individual agenda and toward achieving an interpersonal agenda simultaneously. Because girls are concerned with preserving relationships at the same time they are trying to achieve individual objectives, Sheldon believes that girls' conflict talk requires more "sociolinguistic sensitivity" than that of boys (Sheldon, 1992a, p. 99). In other words, girls develop a different, and in Sheldon's view more complex, style of social interaction that requires such skills as mitigation and compromise. As a result, girls' interactions are more reciprocal and collaborative than boys' interactions.

Several researchers have examined how these gender differences might develop. Lever (1976) investigated differences in children's play. She found that boys more often played outdoors and in larger groups; both of these circumstances limit the amount of verbal interaction that is feasible or even possible. Girls, on the other hand, preferred indoor activities, which tend to limit physical movement and may foster verbal interaction. Further, she found that boys tended to play more competitive types of games than girls. It can be hypothesized that competitive activities are related to competitive speech acts such as threats or boasting.

Maltz and Borker (1982) have argued that children develop these different styles of language as a result of their participation in segregated peer group activities. Tannen (1990a) also concluded that children learn gender-typed communication styles with same-sex peers that allow them to develop different interactional skills; further, these different skills may lead to difficulties in cross-gender communication. Maccoby (1990) states that girls and boys participate in separate cultures of gender, and this gender segregation leads to differential socialization. Maccoby agrees with Maltz and Borker that these sex-typed patterns of activity lead to differences in interactive styles, and argues similarly to Tannen that these style differences in turn influence not only same-sex interactions, but mixed-sex interactions as well. When males and females interact with each other, females particularly may find that the interactive style they have developed with other females is less effective with males. Males tend not to respond to the less direct types of conversational strategies that females use with each other. As a result, Maccoby states that females sometimes take on a supportive rather than an active role in interactions with males, resulting in a loss of control over the interaction.

McCloskey and Coleman (1992) reported that boys dominated mixed-sex interactions to some extent by using more direct requests and self-promoting speech. In other cases, females alter their interactive style by becoming more assertive, speaking louder, and interrupting males in order to participate more fully in the interaction. For example, Miller et al. (1986) revealed that girls did use conflict mitigation strategies with boys as well as with girls. However, they also used more aggressive, heavy-handed persuasion tactics in interactions with boys that were usually unnecessary with girls. Goodwin (1987) also demonstrated that girls were capable of using more masculine conversation devices with boys, such as direct argument or bragging, and Leaper (1991) found that girls used more controlling speech acts with boys than with other girls. Although both Leaper and McCloskey and Coleman point out that same-sex and mixed-sex interactions are often quite similar, there are also some distinctive differences that characterize mixed-sex interactions that potentially affect both the course of these interactions and the outcomes for the individual children involved, particularly for girls.

While it has been demonstrated that young boys and girls use language in different ways to resolve conflicts during free play, there has been no research with preschoolers in a cognitive problem-solving context to examine gender differences in conflict resolution or task performance. However, this is an important area of study, because there is evidence to suggest that these early language differences that exist between boys and girls may influence cognitive development as well as free play. If these differences in interactional style affect girls' problem-solving performance, their confidence and their ability to perform well in school, where girls and boys are often asked to work together, could also be affected.

Only a few dyadic problem-solving studies have compared same-sex and mixed-sex interactions in older children. Most of these studies have been limited to computer-based tasks.

The results of these studies are mixed with regard to problem-solving outcomes for same-sex and mixed-sex pairs. In some cases, mixed-sex pairs perform worse than same-sex pairs (Hughes, Brackenridge, Bibby, & Greenough, 1988; Underwood, McCaffrey, & Underwood, 1990); in other cases, the difference is reversed (Barbieri & Light, 1992). Still other studies find no differences in performance (Littleton, Light, Joiner, & Barnes, 1992; Pozzi, Healy, & Hoyles, 1993). Only three of these studies included measures of the interactions that could explain differences in performance between same-sex and mixed-sex pairs. Two of the studies did not show relationships between interaction style measures and performance (Barbieri & Light, 1992; Pozzi et al., 1993). In the third study, mixed-sex pairs used a less effective turn-taking style of interaction, while same-sex pairs engaged in a more beneficial mutual decision-making style (Underwood et al., 1990).

Three studies have examined same-sex and mixed-sex interactions in other problem-solving contexts. Cannella (1992) explored same-sex and mixed-sex interactions for spatial perspective-taking tasks. She found that male same-sex pairs performed better on these tasks than either female same-sex pairs or mixed-sex pairs. One explanation for the lower performance of female pairs was that they exhibited more disagreements without explanations than other types of pairs. Another study examined characteristics of same-sex and mixed-sex interactions on a science laboratory experiment (Madhok, 1992). Madhok found that boys tended to dominate mixed-sex interactions. Girls' input to the task was limited for mixed-sex triads because boys often ignored or criticized girls' comments or suggestions. Finally, a study by Holmes (1994) examined second-grade same-sex and mixed-sex discussions of social knowledge problems. This study indicated that girls in mixed-sex dyads adapted their level of reasoning to their male partners' level of reasoning. Girls' level of reasoning improved when they interacted with a higher-level boy, and declined when they interacted with a lower-level boy. Boys in mixed-sex pairs also improved when they interacted with higher-level girls, but they did not show the same decline in reasoning when paired with lower-level girls. These findings indicate that girls are more susceptible to boys' influence than vice versa. More important, though, they indicate that girls' cognitive performance may be affected by the type of interaction in which they engage.

Although all of these studies provide some information about the effects of gender on dyadic problem-solving, two important issues have yet to be examined. First, none of these studies were concerned with gender differences in conversational style. Second, all of the problem-solving studies were with older children, while the free play literature on conversational style focuses on preschool children. The goal of the present study, then, is to investigate the relationship between gender-typed features of children's interactions discussed previously and children's performance on cognitive problem-solving tasks. A further goal is to extend this research to a preschool sample to determine whether the gender differences in language that are already apparent by this age are affecting young children's cognitive performance. A final goal will be to compare children's conversational styles and task performance on three different problem-solving tasks. This sort of task comparison is relatively rare in the literature, particularly among studies that have examined gender differences in collaboration. Thus, we have little information about how task differences might influence same-sex versus mixed-sex collaborative processes and outcomes. For example, tasks that force children to work together more often during the interaction might generate different types of discussion or behavior than tasks that allow children to work more independently. Similarly, tasks that do not allow children to make decisions and then alter them may stimulate different processes of interaction than tasks that allow children to more easily modify earlier decisions.

The tasks in the proposed study are similar to tasks that have been used in problem-solving studies with older children. Two of the tasks involve using Tinkertoys to either copy a model of a tower or build something the children choose together. The other task involves stringing beads according to a set of rules specifying which beads can be next to one another and which beads cannot. These tasks are not identical to tasks used in previous studies. However, they are characterized by a number of features that are common in other peer collaboration studies. These include spatial reasoning, construction, planning, and following rules (Azmitia, 1988; Bearison, Magzamen, & Filardo, 1986; Duran & Gauvain, 1993; Ellis, Schneiders, & Smith, 1991; Mugny & Doise, 1978).

These tasks were selected on the basis of several criteria. First, the tasks involved objects, since preschoolers are not likely to collaborate about purely verbal problems; however, the tasks also had to elicit conversation and some conflict from the children as they worked on them. Second, the tasks included an ultimate goal or solution, but with varying degrees of success possible. Third, the tasks included a series of steps involved in reaching the final goal. Fourth, the tasks tapped different problem-solving skills. Finally, the tasks were enjoyable for the children.

METHOD

Participants

Participants were 60 children between the ages of 3 years 11 months and 5 years 5 months (mean age = 4 years 8 months). Children were recruited from local preschools on the basis of parental permission letters. Children were randomly assigned to one of three types of dyads: 10 same-sex boy dyads, 10 same-sex girl dyads, or 10 mixed-sex dyads. All dyads were formed within classrooms, and had a maximum of a 6-month age difference between partners.

Procedure

Each child participated in one testing session with either a same-sex or an opposite-sex partner. All sessions were conducted by a female experimenter at the children's school, and lasted approximately 20 minutes. The children participated in three tasks: two structured problem-solving tasks (copying a Tinkertoy model and stringing colored wooden beads) and one unstructured task (building a Tinkertoy structure of the children's own design). The model-copying Tinkertoy task was always followed by the open-ended Tinkertoy task, and these two tasks were counterbalanced for order with the bead task.

For the model-copying task, the children were shown the model and given the following instructions:

> See this tower? I want you to build a tower that looks just like this one. I want you to build the tower together. You're going to work together to do it. So you have to talk to each other to decide how you're going to build the tower, which pieces go where, and who is going to put each piece on.

The children were given a plastic container holding 20 Tinkertoy pieces (12 Tinkertoy sticks and 8 connectors). Four of these (2 sticks and 2 connectors) were extra pieces that were not needed to complete the task. The container was placed between the children and they were allowed to begin the task.

For the open-ended Tinkertoy task, the instructions were as follows:

> You're going to build something with the Tinkertoys again. But this time, I want you to decide what you are going to build. It's really important that you build one thing together. So you have to work together. You have to talk to each other to decide what you are going to build and what it is going to look like. You have to talk to each other to decide who is going to put each piece on and where each piece will go.

The children were then given a second set of 20 Tinkertoy pieces (again, 12 sticks and 8 connectors) and allowed to complete the task.

The third task was to complete a bead stringing problem. The children were given the following instructions:

> See these beads? You're going to put these beads on this string. Now, some of the beads like to be touching each other. This card shows you which two colors need to be together? [A 3 1/2" x 5" index card was placed on the floor between the two children. The card was illustrated with a happy face at the top, and pink and purple circles representing the bead colors at the bottom.] There's a happy face to tell you that these beads like each other and want to touch each other.
>
> We also have some other beads that don't like each other. These beads can't touch each other. This card shows you which two other colors can't touch? [A second card was placed directly below the first card on the floor. This card was illustrated with a sad face at the top and green and yellow circles at the bottom.] There's a sad face on these cards to tell you that these beads don't like each other and can't touch.
>
> The other colors you can put wherever you want to, and you use all the beads. Do you remember which colors need to be touching? Do you remember which colors can't touch?
>
> Now, something else that's really important about this game is that you work together to do it. So you have to talk to each other to decide how you're going to string the beads, which colors go together, and who is going to put them on the string.

A third container holding 13 colored beads (3 yellow, 2 green, 2 pink, 1 purple, 3 red, and 2 blue) and the string was placed between the two children and they were asked to begin the task.

The experimenter remained in the room, intervening only when necessary (to answer questions or in cases where one or both children became very upset). All sessions were videotaped.

Teacher Questionnaire

A short questionnaire was also administered to each child's teacher. The purpose of this questionnaire was to gather further information about the type of relationship each pair of children had prior to the study. It consisted of five questions scored on a 5-point Likert scale. The complete questionnaire is presented in the Appendix.

Scoring

Language Measures

All sessions were transcribed using the CHAT (Codes for the Human Analysis of Transcripts) transcription system and the scored transcripts were tabulated using the CLAN scoring system from the CHILDES (Child Language Data Exchange System) project (MacWhinney, 1991). This system allows calculation of frequencies of various types of speech acts. In addition, the CLAN system allows for sequential analyses of conversational turns. Conversational turns were scored using categories from Eisenberg and Garvey (1981) and Goodwin (1988), as well as categories developed by the author. The following language categories were used:

1. Aggressive turns--Speaker issues an aggressive directive or challenge to partner. For example, the speaker might issue a direct command like, "Put the green one on now."

2. Insistence--Speaker repeats or reinforces an initial utterance.

3. Ignores--No response to request or directive from partner.

4. Threats--Threatening physical force or emotional loss, such as a loss of friendship.

5. Mitigated turns--Speaker issues a mitigated directive or challenge to partner. Here, the speaker tries to soften the command by putting it in the form of a joint plan or suggestion, such as "We'll put the blue one on now, ok?"

6. Compromise--Proposal of some form of sharing, such as taking turns.

7. Reason--Speaker gives a reason for his or her behavior or why some particular course of action should be pursued.

8. Problem-Solving--Problem-solving strategies such as evaluating the dyad's progress or stating the next step in the task (not stated as a directive or counter).

9. Counter--Verbal disagreement with partner.

10. Agreement--Verbal agreement with partner.

11. Request for information--Asking partner for task-related information.

12. Talk about the task--Miscellaneous comments about the task that are not directives, counters, or problem-solving strategies. For example, physical descriptions of the materials.

13. Off-Task turns--Talk not directly related to the task.

14. Experimenter--Talk directed toward the experimenter.

Behavioral Measures

Children's behavior involving the task materials was also coded for the three tasks. This system had two goals. The first was to track children's moment-by-moment success or failure for selection and placement of individual task pieces for the model-copying Tinkertoy task and the bead task. The second was to code children's behavior toward one another involving task materials. The following categories were used:

1. Selection of piece (scored as correct or incorrect for model-copying version of the Tinkertoy tasks and the bead task).

2. Placement of piece (scored as correct or incorrect for model-copying version of the Tinkertoy tasks and the bead task).

3. Attempted placement--Child touches the model or string with a piece and then decides not to place it. Child places piece but does not remove his or her hand from the piece and then removes the piece.

4. Replacing piece--Piece that has fallen off model or string or is taken off is replaced by child in same location; if it is placed in a new location, it is scored as a placement.

5. Rejecting own piece--Piece has been selected (selection is scored), but the child does not touch the model or string with the piece before putting it down.

6. Removal of piece after a placement has occurred.

7. Offering piece to partner.

8. Offering piece in response to verbal command/request from partner.

9. Taking piece that is offered by partner.

10. Rejecting piece that is offered by partner.

11. Taking piece from partner and then rejecting the piece.

12. Taking piece from partner.

13. Blocking partner's attempt to place a piece.

14. Gesture toward model or piece.

Joint Decision-Making Measures

Both tasks involved many decision points about how to divide labor and materials. For example, each dyad had to decide which piece or bead would be selected, as well as how and where it would be placed. In addition, the dyad had to decide who would place each Tinkertoy piece or bead. Joint decision-making was measured by scoring one of the following outcomes for each selection and placement:

1. One child selects or places task material without partner's involvement.

2. Child's selection or placement is unsuccessfully challenged by the partner. A challenge may be verbal (a criticism or directive to stop the action being engaged in) or physical (trying to block the child's action or take task material from the child). The partner's challenge would be considered unsuccessful if the child makes a counterargument, or ignores the challenge.

3. Child's selection or placement is successfully challenged by the partner. The challenge is considered successful if the child alters or abandons the selection or placement because of the partner's challenge.

4. Both children jointly select or place task material. Joint decision making was scored when children discussed a selection or placement before it occurred.

5. One child makes the decision about selection or placement, but it is the partner who carries out the decision.

6. The child abandons the decision--the piece is never selected or placed.

7. The child agrees to the partner's decision after the fact.

Overall Task Success

Finally, the quality of children's overall task completion was also scored. Task success was scored for the bead task and the model copying version of the Tinkertoy task. Task success was measured by dividing the number of Tinkertoy pieces or beads correctly placed by the total number of pieces or beads placed. Pieces or beads that should have been placed but were not were counted as incorrect placements.

Reliability

All scoring was done by the first author. For the language measures and the behavior measures, a random sample of 30% of the dyad transcripts was independently coded by a female undergraduate research assistant for interrater reliability. Reliability ranged from .73 to .91 for the discussion categories (average reliability = .82). Reliability figures for the behavioral categories were between .80 and .95 (average reliability = .88). For the joint decision-making measures, a random sample of 30% of the dyad transcripts was independently coded by a second female undergraduate research assistant. Reliability for these categories ranged from .83 to 1.00 (average reliability = .91).

RESULTS

The analyses were directed to three general goals. The first was to determine whether there were any differences among the three pair types for the language categories, behavioral measures, or the joint decision-making measures. The second was to determine whether there were any gender differences for the three sets of measures. Analysis of variance was used to test for gender and pair type differences. The final goal was to test for relationships between the language measures and the behavioral measures with a series of correlation matrices.

For the purposes of analysis, several of the language and behavior categories were combined. Because the main comparison of interest for both sets of categories was between aggressive and mitigated speech and behavior, the summary categories reflect this distinction. For the language codes, an aggressive category was formed by combining aggressive turns, ignores, insistences, and threats. A mitigated category was formed by combining mitigated turns and compromises. In addition, information was the sum of problem-solving turns and requests for information. Finally, off-task conversation and talk about the task were combined to form a miscellaneous category. For the behavior codes, an aggressive category was formed by combining taking task materials, taking and rejecting materials, rejecting partner's offer of materials, and blocking the partner. Offering materials, taking materials offered by the partner, and offering pieces in response to verbal commands formed the mitigated behavior category. A third summary category was created to reflect cases of indecision; this category was the sum of attempted placements, removals, replacements, and rejecting own materials. All analyses were performed using frequency scores for each of these categories; summary variables were computed by adding frequencies for the individual codes.

For the model-copying Tinkertoy task and the bead task, two ratio scores were also calculated to determine how efficient children were in their accurate completion of these tasks. Simply because children had high frequencies for correctly selecting and placing pieces did not mean they were the most successful dyads in their completion of the tasks. For example, a dyad might have made a number of correct selections or placements but then changed their minds, or partially completed the task correctly but then removed all of the materials and started over. The performance of these dyads would not be considered as efficient as that of dyads who completed the task correctly from the beginning and did not alter correct selections or placements of materials. The ratio scores were computed by dividing the number of correct selections or placements of task materials by the sum of correct and incorrect selections or placements.

Pair Type Differences

The length of children's discussions was measured by the number of conversational turns. Each utterance by a child that was bounded by either a pause in the conversation or an utterance by the other child was considered a turn. The length of children's discussions on each of the tasks was approximately equal across pair types. For the model-copying Tinkertoy task, children averaged 24.78 turns, on the open-ended Tinkertoy task, children talked for an average of 23.05 turns, and children averaged 17.48 turns on the bead task.

The first pair type analysis was for differences in the overall success measure for the model-copying Tinkertoy and bead tasks. The ratio scores for success were subjected to a 3 (Pair Type: Same-Sex boys, Same-Sex girls, Mixed-Sex) x 2 (Task: Tinkertoy, Bead) mixed-model ANOVA. There were no significant differences in performance across pair type.

Results also did not reveal significant differences in performance for the two tasks. The means were .74 for the model-copying Tinkertoy task and .70 for the bead task.

After the summary categories were formed, there were eight language categories and eight behavior measures (six for the open-ended Tinkertoy task). Each of these was subjected to a 3 (Pair Type: Same-Sex girls, Same-Sex boys, Mixed-Sex) x 3 (Task: Model-Copying Tinkertoy, Open-ended Tinkertoy, Bead) mixed-model ANOVA. Separate ANOVAs were conducted because the a priori comparisons of interest were the effects of pair type and trial on each variable individually, rather than comparisons within the language categories or within the behavior categories.

These analyses revealed a significant main effect of trial for one of the language categories--the information category, $\underline{F}(2,114) = 6.06$, $\underline{p} = .0032$. Children asked for or received task-related information from their partners about six times on both the Tinkertoy tasks ($\underline{M} = 6.90$ for the model-copying Tinkertoy task and $\underline{M} = 6.13$ for the open-ended Tinkertoy task), but did so less often on the bead task ($\underline{M} = 4.48$). For the behavior categories, a main effect of pair type was significant for aggressive behaviors, $\underline{F}(2,57) = 3.22$, $\underline{p} = .047$. Mixed-sex dyads engaged in these behaviors almost twice as often ($\underline{M} = 4.02$) as same-sex dyads ($\underline{M} = 2.00$

for same-sex female dyads and M = 2.68 for same-sex male dyads). This finding is consistent with previous research indicating that mixed-sex interactions often involve a clash of collaborative styles that boys and girls develop in same-sex interactions, and children may alter their behavior with other-sex partners as a result.

A main effect of trial was also significant for several of the behavioral categories. Children used more mitigated behaviors, $F(2,114) = 16.29$, $p = .0001$, on the bead trial ($M = 4.13$) than on either of the Tinkertoy trials ($M = 2.08$ for the model-copying task and $M = 1.50$ for the open-ended task). Since the bead trial typically involved only one child putting a bead on the string at a time, more of the materials needed to be passed back and forth between the children than on the Tinkertoy trials.

The main effect of trial was also significant for the gesture category, $F(2, 114) = 3.96$, $p = .022$, and the indecision category, $F(2, 114) = 26.91$, $p = .0001$. In contrast to the mitigated behavior category, however, means for these categories indicated that children used more gestures on the Tinkertoy trials ($M = 3.53$ for the model-copying task and $M = 3.80$ for the open-ended task) than on the bead trial ($M = 2.23$). The same pattern of means emerged for the indecision category ($M = 16.07$ and $M = 16.75$

for the model-copying Tinkertoy task and the open-ended Tinkertoy task, respectively, and M = 3.73 for the bead task). Children were more likely to change the locations of task materials on the Tinkertoy trials than on the bead trials, in part because removing materials on the bead trial involved removing more than one bead, while Tinkertoy pieces could easily be moved one at a time. In addition, there were more pieces involved on both the Tinkertoy trials than on the bead trial, so there were more decisions to be made by the children and consequently more opportunities for those decisions to be altered.

Trial differences also emerged on the categories used to code correct and incorrect selections and placements for the model-copying Tinkertoy task and the bead task. For the selection measures, a main effect of trial was significant for the frequency of correct selections, $F(1,57) = 9.14$, $p = .004$, the frequency of incorrect selections, $F(1,57) = 38.96$, $p = .0001$, and the ratio measure for correct selections, $F(1,57) = 46.94$, $p = .0001$. For the frequency measures, children made more correct and incorrect selections on the Tinkertoy task (M = 8.38 and M = 9.23, respectively) than on the bead task (M = 6.05 for correct selections and M = 2.23 for incorrect selections). For the ratio selection measure, however, children's correct selections as a percentage of their total number of selections was higher for the bead task ($\underline{M}$ = .77) than for the Tinkertoy task ($\underline{M}$ = .51). These same trial effects were significant for the placement measures, $\underline{F}(1,57) = 7.95$, $\underline{p}$ = .007, for correct placements, $\underline{F}(1,57) = 20.62$, $\underline{p}$ = .0001, for incorrect placements, and $\underline{F}(1,57) = 4.42$, $\underline{p}$ = .04, for the ratio measure of correct placements. Children again exhibited higher frequencies of correct and incorrect placements on the Tinkertoy task ($\underline{M}$ = 6.67 and $\underline{M}$ = 5.13, respectively) than on the bead task ($\underline{M}$ = 4.48 for correct placements and $\underline{M}$ = 1.58 for incorrect placements). Conversely, the mean for ratio measure of correct placements was again higher for the bead task ($\underline{M}$ = .72) than for the Tinkertoy task ($\underline{M}$ = .62). The effects for the frequency performance measures are somewhat artificial, however, as the number of possible selections and placements was higher for the Tinkertoy task than for the bead task.

For the joint decision-making scores, a 3 (Pair Type: Same-Sex Girls, Same-Sex Boys, Mixed-Sex) x 7 (Decision-making) mixed-model ANOVA was conducted on the seven levels of decision-making. Separate ANOVAs were performed for each trial. No pair type effects were significant for these analyses. All three ANOVAs revealed significant main effects of decision-making for each trial, $\underline{F}(6,342)$ =

105.48, p = .0001, for the model-copying Tinkertoy task, $F(6,342)$ = 135.64, p = .001, for the open-ended Tinkertoy task, and $F(6,342)$ = 121.69, p = .0001, for the bead task. Examination of the means revealed that most decisions made by the children on all three tasks were made by one child alone. Means for the joint decision-making categories on all three trials are presented in Table 1.

Gender Differences

The second goal for the analyses was to simultaneously test for differences across both gender and pair type. However, these analyses could not be performed on all 60 children because the data from same-sex pairs were not independent and because the pair types were not fully crossed. To address this issue, the scores for children in same-sex pairs were averaged, so that 20 sets of scores from same-sex dyads were compared with 20 sets of scores from mixed-sex dyads.

As with the analyses that examined pair type alone, each of the language and behavior categories was tested separately. Each analysis was a 2 (Pair Type: Same-sex, Mixed-sex) x 2 (Gender: Male, Female) x 3 (Trial: Model-copying Tinkertoy, Open-ended Tinkertoy, Bead) mixed-model ANOVA. For the language categories, a main effect of gender was significant for children's mitigated speech, $F(1,36)$ =

Table 1

Means for Joint Decision-Making Categories by Trial and Pair Type

	Same-Sex Female Dyads	Same-Sex Male Dyads	Mixed-Sex Dyads
	Model-copying Tinkertoy Task		
Individual Decisions	33.60	33.90	33.95
Unsuccessful Challenges	1.70	1.95	1.80
Successful Challenges	3.25	1.85	3.45
Joint Decisions	1.40	0.20	0.40
Partner-Executed Decisions	2.10	0.95	1.45
Abandoned Decisions	4.30	4.05	3.30
Agreements	0.50	0.30	0.45
	Open-ended Tinkertoy Task		
Individual Decisions	39.30	4.05	36.70
Unsuccessful Challenges	0.50	1.85	1.10
Successful Challenges	1.75	1.60	3.25
Joint Decisions	0.20	0.10	1.00

Table 1--continued

Partner-Executed Decisions	0.70	0.35	1.25
Abandoned Decisions	4.60	2.35	4.10
Agreements	0.35	0.55	0.95
	Bead Task		
Individual Decisions	11.80	14.00	12.35
Unsuccessful Challenges	0.95	2.05	0.80
Successful Challenges	1.05	1.85	1.45
Joint Decisions	0.80	1.00	1.40
Partner-Executed Decisions	1.85	1.35	1.70
Abandoned Decisions	1.45	0.75	1.60
Agreements	0.65	0.15	0.50

5.18, p = .029. Girls in both same-sex and mixed-sex pairs used more mitigated speech (M = 3.36) across all three trials than did boys (M = 2.04). This finding supports previous research on gender differences in children's language use, and provides the first evidence that such differences exist for preschool children's problem-solving interactions.

Two main effects were also significant for the information language category. The first was a pair type main effect, F(1,36) = 3.58, p = .067. The second was a main effect of trial, F(2,72) = 5.55, p = .0057. Mixed-sex dyads offered and requested more information from their partners (M = 7.02) than same-sex dyads (M = 5.25). Children also offered and requested information from one another most often on the model-copying Tinkertoy task, followed by the open-ended Tinkertoy task and the bead task. Means for these trials were 7.13, 6.63, and 4.61, respectively.

For the behavior categories, a main effect of trial was significant for mitigated behaviors, F(2,72) = 8.92, p = .0003. As with the analyses for pair type alone, children used more mitigated behaviors on the bead task (M = 4.20) than on either the model-copying (M = 2.21) or open-ended Tinkertoy tasks (M = 1.68). A main effect of trial was also significant for the indecision category, $F(2,72) = 18.66$, $p = .0001$. Again, the pattern of means for this effect was similar to that for the analyses involving only pair type. Children altered their choices about selections or placements much more often on the Tinkertoy trials ($M = 16.40$ for the model-copying task and $M = 17.58$ for the open-ended task) than on the bead trial ($M = 3.69$).

Trial differences also emerged for the analyses involving correct and incorrect selection and placement of pieces on the model-copying Tinkertoy task and the bead task. The effects are identical to those reported for the analyses involving only pair type. Trial effects were significant for correct selections, $F(1,36) = 7.19$, $p = .01$, incorrect selections, $F(1,36) = 22.64$, $p = .0001$, the ratio measure for correct selections, $F(1,36) = 37.67$, $p = .0001$, correct placements, $F(1,36) = 8.75$, $p = .005$, incorrect placements, $F(1,36) = 14.03$, $p = .0006$, and the ratio measure for correct placements, $F(1,36) = 6.00$, $p = .02$. The patterns of means for these analyses are also identical to those involving only pair type and therefore will not be reported.

The decision-making codes were analyzed using a 2 (Pair Type) x 2 (Gender) x 7 (Decision-Making) mixed-model ANOVA. Separate ANOVAs were conducted for each trial. The effects for these analyses were identical to those for the analyses involving only pair type. A main effect for type of decision was found for all three trials, *F*(6,216) = 84.52, *p* = .0001, for the model-copying Tinkertoy task, *F*(6,216) = 97.26, *p* = .0001, for the open-ended Tinkertoy task, and *F*(6,216) = 93.46, *p* = .0001, for the bead task. Again, children made more individual decisions than any other type of decision about selection or placement of task materials. The pattern of means for these analyses is very similar to that for the analyses involving pair type alone; in addition, the means already presented in Table 1 are more informative than the means on averaged scores in the present analyses. The means in Table 1 will therefore be used to represent the effects from both sets of analyses.

Correlations

The third goal for the analyses was to examine relationships among the language measures and the behavioral measures, including various measures related to task performance. These relationships were examined using a series of correlation matrices. Because the relationships between language, decision-making and behavior depend upon contributions to the interaction made by both members of the dyad, correlations were performed on dyad scores for each of the three types of measures. The dyad scores were computed simply by summing the individual frequency scores for each member of the dyad. Correlations were performed on the whole sample as well as within pair type and were conducted separately for each trial, resulting in a series of 12 matrices.

The correlations for the entire sample on the model-copying and bead tasks will be discussed first. For the model-copying Tinkertoy task, aggressive speech and counters were positively correlated with both incorrect selections and placements. However, aggressive speech was also positively correlated with correct selections and counters were correlated with correct placements. These correlations indicate that interactions involving typically masculine speech are associated with more correct choices about task materials, but are also associated with making more mistakes in choosing and placing materials. Mitigated speech was negatively correlated with overall success on this task, suggesting that speech more characteristic of female interactions may not be the most beneficial for accurately copying a Tinkertoy model. Agreements were positively correlated with correct selections, indicating that when children agreed, they were more likely to choose the correct Tinkertoy piece. The ratio measures for correct selections and placements did not correlate significantly with any of the verbal measures for this task. All of these correlations are presented in Table 2.

On the bead task, the patterns of correlations were slightly different. Here, aggressive speech was positively correlated only with incorrect placements, and was negatively correlated with the ratio measure for correct placements ($r = -.37$, $p = .048$). Counters were also negatively correlated with the ratio measure for correct placements ($r = -.43$, $p = .012$), and were positively correlated with both incorrect selections and placements. In addition, mitigated speech was positively correlated with overall performance. For this task, then, children performed better when they presented joint plans and offered compromises, and performed less well when they engaged in directive, confrontational kinds of talk. With the exception of the ratio scores for correct selections and placements, all significant correlations between verbal and performance measures on the model-copying Tinkertoy task and the bead task for the sample as a whole are presented in Table 2.

Correlations were also used to examine the relationship between aggressive and mitigated behaviors and both verbal and performance measures. For the Tinkertoy task, aggressive behavior was positively correlated with both the

Table 2

Correlations Between Verbal and Performance Measures for the Model-copying Tinkertoy Task and Bead Task

	Correct Selections	Incorrect Selections	Correct Placements	Incorrect Placements	Overall Success
			Model-copying Tinkertoy Task		
Aggressive Speech	.44*	.38*		.40*	
Mitigated Speech					-.36*
Counters	.53**		.39*		
Agreements	.41*				-.46*
Reasons					
Information	.43*	.47**			
Miscellaneous		.58**		.50**	
Experimenter-Directed Speech	.49**	.39*		.42*	
			Bead Task		
Aggressive Speech				.45*	
Mitigated Speech					-.42*
Counters		.48**		.46*	
Agreements	.57**	.57**			
Reasons					

Table 2--continued

Information		
Miscellaneous	.54**	.47**
Experimenter-Directed Speech		

Note. All nonsignificant correlations were omitted.

*$p < .05$. **$p < .01$

aggressive speech category and counters. This category was also correlated with correct selections. For the bead task, the patterns of correlations for these categories were identical. Aggressive behavior was positively correlated with aggressive speech and counters, and was also positively correlated with correct selections. These correlations indicated that verbal aggression was associated with physical aggression. In addition, children who were physically more directive on both of these tasks were more likely to correctly choose task materials. For both tasks, the ratio measures for correct selections and placements were not correlated with these two behavioral measures. All significant correlations between the verbal and performance measures and aggressive and mitigated behaviors are presented in Table 3.

On the open-ended Tinkertoy task, correlations for the whole sample revealed relationships between mitigated talk and selection of pieces ($\underline{r} = .38$, $\underline{p} = .04$) and placement of pieces ($\underline{r} = .37$, $\underline{p} = .044$). When children were not given a specific goal, mitigated talk was associated with higher frequencies of selection and placement of Tinkertoy pieces. Offering and requesting information was also associated with more selections ($\underline{r} = .40$, $\underline{p} = .027$) and placements ($\underline{r} = .40$, $\underline{p} = .03$). As on the other two tasks, aggressive behaviors

Table 3

Correlations Between Behavior Measures and Verbal and Performance Measures for Entire Sample

	Aggressive Behavior	Mitigated Behavior
	Model-copying Tinkertoy Task	
Aggressive Speech	.71**	
Mitigated Speech		
Counters	.51**	
Agreements		
Reasons	.50**	
Information	.40*	
Miscellaneous		
Experimenter-Directed Speech		
Correct Selections	.53**	
Incorrect Selections		
Correct Placements		
Incorrect Placements		
Overall Success		

Table 3--continued

	Bead Task	
Aggressive Speech	.51**	
Mitigated Speech		
Counters	.51**	
Agreements		
Reasons		
Information		
Miscellaneous		.47**
Experimenter-Directed Speech		
Correct Selections	-.40*	
Incorrect Selections		
Correct Placements		
Incorrect Placements		
Overall Success		

Note. All nonsignificant correlations were omitted.

*$p < .05$. **$p < .01$

were again positively correlated with aggressive talk (r = .36, p = .05). These behaviors were also correlated with giving more reasons (r = .38, p = .04).

Correlations were also performed within pair type. Those correlations that differ in important ways from those for the sample as a whole will be discussed. On the model-copying Tinkertoy task, giving reasons was associated with more correct selections for same-sex female pairs (r = .64, p = .048), but was associated with worse overall performance for same-sex male pairs (r = -.65, p = .042). This finding suggests that offering justification for a particular course of action may be beneficial for girls' performance but detrimental to boys' performance. For this task as well, counters were negatively associated with overall performance for same-sex female dyads (r = -.80, p = .006), but not for same-sex male dyads or mixed-sex dyads. Girls tended to perform worse, therefore, when frequent disagreements occurred during their interactions with one another.

For mixed-sex pairs, several correlations are of interest. First, the negative correlation between mitigated speech and overall performance on the Tinkertoy task for the entire sample was significant only for mixed-sex pairs (r = -.76, p = .011) when examined within pair type. Mitigated speech was also positively correlated with incorrect selections (_r_ = .78, _p_ = .008) and incorrect placements (_r_ = .73, _p_ = .016) only for mixed-sex pairs. Mitigated speech, then, seems to negatively affect performance when boys and girls interact with one another, but not in same-sex interactions. Finally, miscellaneous talk was associated with incorrect selections and placements only for mixed-sex pairs (_r_ = .80, _p_ = .006, for selections and _r_ = .81, _p_ = .005, for placements). In fact, miscellaneous talk was positively correlated with correct selections for same-sex female pairs (_r_ = .65, _p_ = .043). Talk not directly related to completing the task seems to serve a positive function for female dyads, but may inhibit performance when girls interact with boys.

For the bead task, the correlations within pair type revealed different patterns of results from those for the model-copying Tinkertoy task. For example, performance for same-sex male pairs was negatively associated with aggressive talk. Aggressive speech was positively correlated with incorrect selections (r = .95, _p_ = .0001) and incorrect placements (_r_ = .83, _p_ = .003) and was negatively correlated with the ratio measure for correct placements (_r_ = -.78, _p_ = .008). The same pattern of correlations was found for counters with same-sex male pairs (_r_ = .95, _p_ = .0001 for incorrect selections, _r_ = .78, _p_ =

.007, for incorrect placements, and r = -.76, p = .01, for ratio of correct placements). In addition, reasons were positively correlated with correct selections (r = .68, p = .03) and overall performance (r = .65, p = .043) for same-sex male dyads on the bead task, but not for female dyads as was the case for the Tinkertoy task. Finally, aggressive behaviors were negatively correlated with the ratio measure for correct selections for same-sex male dyads (r = -.92, p = .002) and for mixed-sex dyads (r = -.75, p = .013); however, aggressive behaviors were positively correlated with the ratio measure for correct placements for same-sex female dyads (r = .74, p = .014). So for this task, aggressive behavior was associated with fewer correct selections for male dyads and mixed-sex dyads, but with more correct bead placements for girls in same-sex pairs. Relationships between aggressive talk, aggressive behavior, and task performance, then, appear to depend not only on the composition of the dyad but also on the type of task.

When the correlations for the open-ended Tinkertoy task were examined within pair type, some differences from the correlations for the entire sample emerged. Aggressive speech, rather than mitigated speech, was correlated with selections (r = .72, p = .019) and placements (r = .77, p = .009) for mixed-sex dyads. Mitigated speech was still positively correlated with selections (r = .82, p = .003) for these dyads, however. For mixed-sex dyads alone, agreements were associated with higher frequencies of mitigated behaviors (r = .67, p = .035). Finally, reasons were correlated with aggressive behavior (r = .86, p = .001) only for same-sex male dyads.

Teacher Questionnaire

The teacher questionnaire was used to obtain additional information about each child's classroom behavior based on the teacher's assessment. Teachers were asked to rate each child's behavior in terms how dominant the child typically was in his or her interactions with other children, how often the child played with children of the same or the other sex, and how often each child usually played with the child who was his or her partner in this study. The number of children teachers assigned to the various categories on the questionnaire is presented in Table 4. For the purposes of presentation, the categories "very infrequently" and "somewhat infrequently" have been combined, and the categories "very frequently" and "somewhat frequently" have also been combined.

The descriptive information from the questionnaire indicates that there were some pair type differences in the frequencies with which children played together in their

Table 4

Teacher Ratings of Children's Classroom Behavior

	Infrequently	Sometimes	Frequently
	Same-sex Male Dyads (n = 17)		
Frequency with which children play together	11	4	2
Frequency with which children play with other children of the same gender	0	9	8
Child tends to direct activities	7	4	6
Child dominates discussions	6	4	7
Child gets own way with others	6	5	6
	Same-sex Female Dyads (n = 18)		
Frequency with which children play together	4	10	4
Frequency with which children play with other children of the same gender	0	6	12
Child tends to direct activities	6	4	8

Table 4--continued

Child dominates discussions	5	6	7
Child gets own way with others	7	5	6
	Mixed-sex Dyads (n = 14)		
Frequency with which children play together	4	6	4
Frequency with which children play with other children of the same gender	1	5	8
Child tends to direct activities	4	3	7
Child dominates discussions	5	4	5
Child gets own way with others	5	2	7

Note: Teachers did not return questionnaires for all children.

day-to-day interactions in the classroom. In addition, most of the children spent the largest proportion of their time playing with same-sex peers. Finally, children were fairly evenly distributed in terms of the level of their dominant behavior toward other children.

DISCUSSION

Previous research on children's peer collaboration has paid insufficient attention to the role of gender in children's problem-solving interactions, particularly gender differences in children's conversational styles. This body of research has also focused primarily on elementary school-aged or older children, but preschool (and even younger) children also engage in collaborative interactions (Azmitia, in press; Brownell & Carriger, 1991; Muller & Perlmutter, 1985). Simultaneously, research on gender differences in children's talk has focused on free play interactions and has ignored problem-solving interactions. The present research provides the first information about the relationship between preschool children's gender-typed conversational styles and their collaborative problem-solving performance. This study was designed to explore the extent to which children would display gender-typed patterns of conversation in a problem-solving context, and whether these gender differences would be associated with differences in task performance. These effects were also investigated across three types of problem-solving tasks.

Such task comparisons are relatively rare in the collaborative problem-solving literature, particularly in studies with young children.

With respect to gender differences in conversational style, children's verbal interactions did not differ across gender, with one important exceptions. Girls in both same-sex and mixed-sex dyads did engage in more mitigated conversation than boys. This finding provides the first evidence that girls use mitigated speech in problem-solving interactions. Girls' tendency to engage in this kind of talk was fairly stable during the interaction, because it did not differ across the three tasks. It is also revealing that girls used more mitigated conversation whether they were paired with other girls or with boys; previous studies have given conflicting results regarding whether girls alter their same-sex pattern of behavior when they interact with boys (Kyratzis, 1992; Leaper, 1991; Maccoby, 1990; Miller et al., 1986). While girls used more mitigated talk than boys, boys did not engage in an aggressive style of conversation significantly more often than girls. It may be that the problem-solving context led children to be more competitive than they might be during free play because they were oriented toward the goal of completing the tasks. As a result, both boys and girls used aggressive conversation to accomplish that goal. One goal for future studies will be to compare children's behavior in both free play and problem-solving environments to determine whether the use of gender-typed conversation is influenced by contextual demands.

With respect to pair type differences, children in mixed-sex dyads asked for and received more task-related information from their partners than children in same-sex dyads. Several possible interpretations exist for this effect. One is that mixed-sex dyads had more difficulty establishing a plan to carry out the tasks, and needed to exchange more information to complete them. An alternative interpretation is that mixed-sex dyads actually communicated more effectively than same-sex dyads, and the more frequent exchange of information was a reflection of effective, rather than ineffective, collaboration. Finally, it is possible that because boys and girls in mixed-sex dyads each brought their own styles of problem-solving and collaboration to the interaction session, they needed to exchange information more often to compensate for the differences in their approaches to completing the tasks (Goodwin, 1988; Maccoby, 1990; Sheldon, 1990).

A second set of verbal measures was used to examine children's patterns of decision-making. These analyses revealed that children made most decisions about selection or placement of pieces alone, without consulting their partners beforehand. In addition, the frequency of the different decision-making categories did not differ across gender, pair type, or task. This suggests that the tendency for preschool children to make most decisions alone even in collaborative contexts is at least somewhat stable. This finding is particularly interesting in light of the fact that the children were repeatedly instructed to work together. We do know that children collaborate more frequently and more effectively as they grow older, however (Azmitia, in press; Azmitia & Perlmutter, 1989; Tomasello et al., 1993). One direction future studies might take is to track the developmental progress of joint decision-making and to examine whether the frequency of challenges or joint decisions increases with age.

Gender and pair type differences were also examined for children's physical behavior. Behavior measures included various assessments of children's performance on the model-copying Tinkertoy task and on the bead task, as well as behaviors that involved the task materials but were not indicators of performance. It is important to note with respect to task performance that the tasks used in this study were at the right level of difficulty for the children. Children completed the tasks with varying degrees of success; floor or ceiling performance effects were not present.

One effect related to gender was significant for the behavioral measures; children in mixed-sex dyads engaged in aggressive behaviors almost twice as often as children in same-sex dyads. Previous research has suggested that because the patterns of interaction children develop are based mainly on contact with children of the same sex, mixed-sex interactions can present challenges for children. It may be more difficult, for example, for children to make their goals understood by their partners, and there may be more conflict as a result (Goodwin, 1988; Maccoby, 1990; Maltz & Borker, 1982; Miller et al., 1986; Sheldon, 1990).

In addition to examining differences across both pair type and gender, this study also compared children's behavior and performance across three different problem-solving tasks. Two of the tasks involved a goal that was determined by the experimenter. For the Tinkertoy task, the goal was to create an exact replica of a model tower presented by the experimenter. For the other, the goal was to string colored beads according to a set of rules. The third task also involved using Tinkertoy pieces, but for this task the goal was defined by the children themselves--

to create together a structure of their own design. The study revealed a number of differences across these three tasks in the kinds of language and behavior exhibited by the children, providing a great deal of new information about how the type of task children are asked to perform may influence patterns of social interaction. It is noted, however, that children for the most part did not behave differently across the three tasks as a function of either their own gender or their partner's gender. For preschool children in this study, then, collaborative performance on different tasks is more similar than it is different in terms of the influence of gender or pair type on collaborative processes and outcomes.

With respect to the language measures, children offered and received more information from their partners on both Tinkertoy tasks than on the bead task. One explanation for this finding is that the Tinkertoy tasks included more pieces for children to choose from, and children also had more choices of placement locations for those pieces. In contrast, the beads could be placed only on the string, and only in a linear fashion. Children may have consulted one another more often on the Tinkertoy tasks since they had more decisions to make. As stated previously, this explanation also fits with the trial effect for the indecision category; children altered decisions more often on the Tinkertoy trials in part because the number of decisions to be made was higher, and also because decisions about selection and placement of pieces were easier to alter. The fact that children displayed more mitigated behaviors on the bead task also fits this interpretation of the different demands of the two types of tasks. The bead task limited children's opportunities for placing task materials, since the beads had to be placed sequentially on the string and placed one at a time. As a result, children were forced to physically interact with one another more often on this task, passing pieces and the string back and forth, to be able to place a particular bead on the string.

Previous research has shown that collaboration can be more effective for certain types of tasks--for example, those that involve reasoning rather than rote learning (Phelps & Damon, 1989), tasks that are of a medium level of difficulty versus tasks that are very complex or very familiar (Perlmutter et al., 1989), and tasks that prevent one child from dominating the interaction (Light & Glachan, 1985). This study, however, examined the influence of task in terms of the different types of discussion each task elicited. Together, these findings indicate that different task demands do stimulate different types of discussion.

When children are given different kinds of opportunities to interact during collaborative problem-solving sessions, the processes of those interactions are affected. Researchers should therefore pay attention to the demands of the particular tasks they select when designing peer collaboration studies.

Previous research on children's peer collaboration has shown that process variables can play an important role in the outcomes of collaborative interactions. While this study focused on gender differences in conversational style, the verbal codes analyzed in the study do tap into processes of interaction considered to be important for collaboration, such as establishing a joint understanding of the task and responding to the partner's ideas (Kruger & Tomasello, 1986; Rogoff, 1990). One of the most important goals for this research was to examine the relationship between children's conversation and their behavior during the task, and to determine whether particular types of language or particular behaviors that occurred during the course of the tasks were related to children's performance. With respect to the first of these objectives, children's speech was related to their behavior during the task. However, in many cases the relationships between language and behavior differed according to both pair type and task. One fairly consistent finding was the relationship between aggressive speech and aggressive behavior. When children were very directive and confrontational in their speech, these qualities were also expressed in their behavior.

Children's language and behavior during the interaction were also related to their performance on the model-copying and bead tasks. Aggressive speech was related to both correct and incorrect choices about selection and placement of pieces on the Tinkertoy task, but only with incorrect selections and placements on the bead task. Depending on the task, then, an aggressive conversational style is typically associated with making more mistakes, but can lead to some correct choices as well. On the bead task, mitigated talk was related to better performance. When choices about how to complete the task are limited, offering joint plans and compromises are more likely to be associated with task success.

Some of the relationships between language and performance differed across pair types. For example, giving reasons was associated with better performance for females in same-sex dyads and worse performance for males in same-sex dyads on the model-copying Tinkertoy task. Miscellaneous talk was also associated with correct selections for girls in same-sex dyads on this task.

According to previous research, offering justifications and using conversation to build and maintain relationships occur more often in female same-sex interactions (McCloskey & Coleman, 1992; Sheldon, 1990). In addition, counters were associated with worse performance for girls in same-sex dyads, but not for the other two pair types. Girls who frequently disagreed with one another appeared to suffer in terms of their performance on the model-copying Tinkertoy task. For this task, then, the findings converge with previous research on girls' free play interactions which suggests that girls use conversation to avoid conflict and pursue joint goals. The present research provides the first evidence that this kind of conversation also appears to play an important role in girls' problem-solving interactions. It is interesting to note that on the bead task, it was boys' performance that was negatively affected by both aggressive speech and aggressive behavior, and positively affected by giving reasons for behavior. The possibility that a typically masculine conversational style could actually put males at a disadvantage in particular contexts has not been addressed by the free play literature, and deserves further study.

In a similar vein, mitigated conversation was negatively related to several measures of children's performance for mixed-sex pairs on the Tinkertoy task. Miscellaneous talk was also negatively correlated with task performance in these dyads. These findings suggest that a typically feminine conversational style may be detrimental to performance for children in mixed-sex dyads. It may be that children in these dyads proposed joint plans that were ignored in favor of incorrect alternatives, or it may be that the joint plans themselves were incorrect. It is important to note that this effect, along with the other pair type effects for the correlations, is task-specific. Future studies that include a variety of tasks will be necessary to determine whether gender-typed patterns of conversation have differential effects on performance based on the gender composition of the dyad.

Several further cautions should be mentioned with regard to interpreting the correlations. It is quite possible that the types of discussion in which children engaged during the interaction had either positive or negative effects on children's performance; this is the interpretation discussed here. It is also possible, however, that the degree of success or failure children experienced during the course of completing the task elicited different types of discussion. A final point is that the correlations were performed on frequency scores.

The possibility exists, therefore, that some of the significant correlations are carried at least in part by the length of the children's discussions.

The present study demonstrates that preschool children can and do collaborate--the children in this study did work together to discuss and complete the three tasks. Further, there were some relations between the types of discussion in which children engaged and their degree of success or failure on the tasks. These relationships also varied across pair types, providing additional evidence that the gender composition of dyads may influence both the processes and outcomes of collaborative interactions. Although the predicted gender differences in styles of negotiation were not as prevalent in this study as might be expected based on previous research on children's free play, there were nevertheless two significant outcomes. Girls used more mitigated discussion in both same-sex and mixed-sex dyads than did boys, and children in mixed-sex pairs used more aggressive discussion than children in same-sex pairs. These findings suggest that gender-typed patterns of conversation are present, at least in a limited sense, in preschool children's problem-solving interactions. We know that gender differences in conversational style become more, rather than less, pronounced with age, continuing into adolescence and adulthood (e.g., Tannen, 1990b). One direction for future research will be to compare children's gender-typed conversation in problem-solving contexts across age groups.

The typical view of preschool collaboration tends to be quite negative. Preschoolers are not thought to be very skilled collaborators because they are egocentric, they lack good verbal negotiation skills, and they are unable to achieve the shared state of understanding thought to be necessary for effective collaboration (Azmitia, in press; Tomasello et al., 1993). The results of the present study only partially support this traditional view. It is the case that children in the present study made most decisions about how to complete the tasks alone, indicating a pattern of individual turn-taking that occurred during the interactions rather than a pattern of joint planning and decision-making that would characterize the collaborative interactions of older children or adults. It is not the case, however, that the children were unable to coordinate their actions or to resist distraction sufficiently to complete the tasks (Azmitia, in press). The converse in fact occurred--all of the children in the study completed all three tasks. In addition, nearly all of the interactions involved discussion about how to complete the tasks, how to deal with problems or mistakes, and division of materials and labor. Finally, the children used a wide variety of verbal strategies to accomplish these goals. These strategies included what Azmitia terms "unilateral conflict resolution strategies" (p. 138) like blocking or insistence that are typical of preschool interactions, but also included strategies like mitigation and problem-solving that are often thought to be present only in older children's interactions.

While I would not argue that preschoolers have the same level of collaborative skill as older children or adults, I would argue that we need a more positive view of what young children are able to accomplish in joint problem-solving interactions. Azmitia (in press) states that preschoolers can be quite good at collaboration in particular contexts; for example, on a very familiar task or during free play. Although the specific tasks in this study were not familiar to the children, the materials were very familiar to them. It may be that when young children do not have to devote a great deal of cognitive energy to familiarizing themselves with the task, they have more resources to devote to managing the social interaction. In this kind of environment, they may be able to display collaborative skills that are there, but are simply hidden, in other problem-solving contexts.

APPENDIX

TEACHER RATING FORM

Teacher's Name ____________________

Child's Name ____________________

1. Compared to the class in general, how often do ______________ and ________________ play together at school?

Very Infrequently	Somewhat Infrequently	Sometimes	Somewhat Frequently	Very Frequently
1	2	3	4	5

2. For the following, circle the number that best represents how often __________________ plays with children of the same or the other sex, compared to the class in general

Tends to play with children of own sex		Tends to play equally often with boys & girls		Tends to play with children of other sex
1	2	3	4	5

3. For the following questions, circle the number that best represents how _____________ behaves most of the time, compared to the class in general.

1	2	3	4	5
Directs activities for other children				Needs to have others direct activities for him/her

1	2	3	4	5
Usually dominates discussions with others				Prefers to listen to what others are saying

Appendix--continued

1	2	3	4	5
Gets own way in interactions with others				Usually gives in to another's requests

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Heather Andrea Holmes was born in Boulder, Colorado, and raised in Gainesville, Florida, and Pensacola, Florida. She received her bachelor's degree in psychology from the University of Florida. She went on to receive her master's and doctorate degrees from the graduate program in developmental psychology at the University of Florida. She leaves her illustrious career at UF for a position as assistant professor of psychology at Southeastern Louisiana University in Hammond, Louisiana. Like her daddy, she's a Gator tried and true, orange and blue all the way through, but now she's off to SLU!!!

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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